Note on the Arc of Light seen round Venus in Transit.

By R. A. Proctor, Esq.

My attention has been directed to remarks made on this subject after the reading of a paper by Mr. Brett relating to *Venus*. The paper itself I need not refer to. But the remarks upon it have raised hopes in some minds that it may be possible to increase the intrinsic brightness of light from a disk or other visible surface (as distinguished from bodies like the stars, which are reduced appreciably to points by distance). For it was assumed, in the first place, that the arc of light seen round *Venus* in transit (whether she is partly or wholly immersed) is really brighter than the Sun's disk; and it was maintained in the second place, that this superior brightness could be accounted for either by the effects of a refractive atmosphere, or by specular reflexion at the surface of *Venus*. If this were so, it would be easy to produce the same effect artificially. The faint light of planetary disks, of nebulæ, of comets, etc., might be strengthened, and at the same time rendered more suitable for direct spectroscopic observation, by interposing something of the nature of a large thermometer bulb—any opaque globe in fact, within a transparent envelope of suitable refractive qualities. This would be an important gain. Unfortunately there is no reason for hoping that it can ever be attained. The apparently superior brightness of the arc of light seen round *Venus*, or round a thermometer bulb held before a gas flame, or the like, is demonstrably due to two causes, neither implying any real accession of brightness, viz.—first, the effect of contrast against the dark disk within the refracting envelope, secondly and chiefly to the fact that the comparison is made between the light of some less brilliant part of the disk or other surface, and light from the whole disk or surface brought into view by refraction. It will be found on careful trial, if the effect of contrast be removed or greatly diminished (which can readily be done), that under no circumstances does the arc of so-called condensed light exceed or even equal in brilliancy the brightest part of the luminous surface beyond. And this, which is found experimentally to be the case, can readily be shown to be necessarily so. In an article entitled 'Notes on Brightness' in a weekly journal of science, I showed four years ago that by no optical contrivances can apparent brightness be increased, though quantity of light can of course be greatly increased. *Venus* in transit does not differ in this respect from a portion of an enormous optical instrument directed towards the Sun, and the same general reasoning applies to her. It is, however, easily seen, if we take her case specially, that the law holds good. Thus, consider a small strip of the Sun's disk lying on a diameter through *Venus*,—take two points along this strip separated by a distance δr so small that the variation of the amount of refrac-

tion by which rays from points along the arc between these points reach the eye of a terrestrial observer may be considered uniform. Suppose that by the effects of refraction the distance δr, which seen directly from the Earth has that apparent length, is reduced in length, when forming a part of the arc of light round *Venus*, to $\frac{1}{k}\,\delta r$, k being greater than unity. Then it is obvious that each pencil of rays from points along the luminous strip δr has its divergency in the plane through the strip, *Venus's* centre, and the Earth's, increased, as $k : 1$, in passing along its course (whatever this may be) through the atmosphere of *Venus*. This follows from the uniform variation of the amount of bending for points differently placed along the strip δr. Hence the eye receives fewer rays from each point of the strip δr in the ratio of $1 : k$. Wherefore, neglecting the absorptive effect of *Venus's* atmosphere,

app. brightness of strip δr seen round edge of ♀ : its app. brightness seen directly

$$:: \frac{\text{light recd. round ♀ from each pt. of strip}}{\text{apparent area of strip as seen round ♀}} : \frac{\text{light recd. from each pt. of strip directly}}{\text{apparent area of strip seen directly}}$$

$$:: \frac{1}{k} \div \frac{1}{k}\,\delta r : \frac{1}{\delta r}$$

$$:: 1 : 1,$$

or the brightness is unchanged.

I may take this opportunity of noting that, in a paper on the Nebulæ recently read before the Royal Society, it is asserted that an irresolvable stellar nebula would diminish in apparent brightness (so far as the stellar part of its light is concerned) with increase of distance. No reasoning is given in support of this assertion; and I can see no reason for withdrawing the reasoning by which, in a paper on the Resolvability of Nebulæ regarded as a Test of Distance, I show (incidentally) that a nebula so long as it remained irresolvable would be of constant intrinsic brightness whatever its distance* (always supposing there is no extinction of light in traversing space).

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Absorption of the Light of Venus by Dark Violet Glass Plates.

By Prof. Zenger.

In October 1876 I observed Venus, to detect spots on it, and so look out for the alleged phosphorescent light of the dark part of the disk. I could observe *Venus* early in the morning during nearly the whole of October; it was then very brilliant, casting a shadow, and by its light making it possible to read the maps on the illuminated wall of the observatory. I could even see

* I have since heard that Prof. Stokes, after the paper had been read before the Royal Society, indicated the error into which its writer had fallen in this respect.